

UNCLASSIFIED

AD NUMBER	
AD342991	
CLASSIFICATION CHANGES	
TO:	unclassified
FROM:	confidential
LIMITATION CHANGES	
TO:	Approved for public release, distribution unlimited
FROM:	Distribution: Further dissemination only as directed by Director, U.S. Naval Research Laboratory, Washington, DC 20375, JUL 1956, or higher DoD authority. NOFORN.
AUTHORITY	
NRL ltr dtd 13 Dec 2007; NRL ltr dtd 13 Dec 2007	

THIS PAGE IS UNCLASSIFIED

CONFIDENTIAL

AD 342991

DEFENSE DOCUMENTATION CENTER

FOR

SCIENTIFIC AND TECHNICAL INFORMATION

CAMERON STATION, ALEXANDRIA, VIRGINIA



CONFIDENTIAL

**Best  
Available  
Copy**

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

NOTICE:

THIS DOCUMENT CONTAINS INFORMATION  
AFFECTING THE NATIONAL DEFENSE OF  
THE UNITED STATES WITHIN THE MEAN-  
ING OF THE ESPIONAGE LAWS, TITLE 18,  
U.S.C., SECTIONS 793 and 794. THE  
TRANSMISSION OR THE REVELATION OF  
ITS CONTENTS IN ANY MANNER TO AN  
UNAUTHORIZED PERSON IS PROHIBITED  
BY LAW.

✓ 627450  
**CONFIDENTIAL**

**NRL Report 481**  
**Copy No. 1**

**PROJECT VANGUARD** ~~REPORT NO. 7~~  
~~PROGRESS THROUGH JULY 15, 1956~~

[UNCLASSIFIED TITLE]

Project Vanguard Staff

⑨ Progress report no. 1 for  
15 Jul 56.

July 27, 1956

Further distribution of this report, or of an abstract  
or reproduction, may be made only with the approval  
of the Classified Material Control Officer, Naval  
Research Laboratory, Washington 25, D. C.

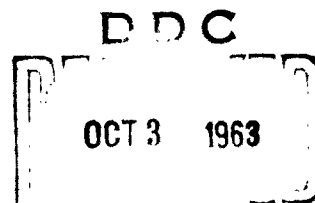
NOT RELEASABLE TO FOREIGN NATIONALS



**PROPERTY OF**  
**OASD (R&D)**  
**TECHNICAL LIBRARY**

**NAVAL RESEARCH LABORATORY**  
**Washington, D.C.**

**CONFIDENTIAL**



# CONFIDENTIAL

## SECURITY

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

### Previous Project Vanguard Reports

Project Vanguard Report No. 1, "Plans, Procedures, and Progress" by the Project Vanguard Staff, NRL Report 4700 (Secret), January 13, 1956

Project Vanguard Report No. 2, "Report of Progress" by the Project Vanguard Staff, NRL Report 4717 (Confidential), March 7, 1956

Project Vanguard Report No. 3, "Progress through March 15, 1956" by the Project Vanguard Staff, NRL Report 4728 (Confidential), March 29, 1956

Project Vanguard Report No. 4, "Progress through April 15, 1956" by the Project Vanguard Staff, NRL Report 4748 (Confidential), May 3, 1956

Project Vanguard Report No. 5, "Progress through May 15, 1956" by the Project Vanguard Staff, NRL Report 4767 (Confidential), June 2, 1956

Project Vanguard Report No. 6, "Progress through June 15, 1956" by the Project Vanguard Staff, NRL Report 4800 (Confidential), June 28, 1956

# CONFIDENTIAL

# CONFIDENTIAL

## SECURITY

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

### Previous Project Vanguard Reports

Project Vanguard Report No. 1, "Plans, Procedures, and Progress" by the Project Vanguard Staff, NRL Report 4700 (Secret), January 13, 1956

Project Vanguard Report No. 2, "Report of Progress" by the Project Vanguard Staff, NRL Report 4717 (Confidential), March 7, 1956

Project Vanguard Report No. 3, "Progress through March 15, 1956" by the Project Vanguard Staff, NRL Report 4728 (Confidential), March 29, 1956

Project Vanguard Report No. 4, "Progress through April 15, 1956" by the Project Vanguard Staff, NRL Report 4748 (Confidential), May 3, 1956

Project Vanguard Report No. 5, "Progress through May 15, 1956" by the Project Vanguard Staff, NRL Report 4767 (Confidential), June 2, 1956

Project Vanguard Report No. 6, "Progress through June 15, 1956" by the Project Vanguard Staff, NRL Report 4800 (Confidential), June 28, 1956

# CONFIDENTIAL

**CONFIDENTIAL**

**CONTENTS**

Problem Status	ii
Authorization	ii
PREFACE	1
COORDINATION WITH OTHER SERVICES	1
Army	1
Air Force	2
THE LAUNCHING VEHICLE	2
Configuration and Design	2
Propulsion	3
Flight Control	7
Electrical Systems	10
Manufacture	10
ELECTRONIC INSTRUMENTATION	11
Vehicle Telemetry	11
Vehicle Tracking	12
Range Safety	13
THE SATELLITE	13
THE MINITRACK SYSTEM	14
DATA PROCESSING	15
Telemetered Data	15
Orbital Data	15
Second-Stage Apogee Prediction	16

**CONFIDENTIAL**

**CONFIDENTIAL**

**PROBLEM STATUS**

This is an interim report; work on the problem is continuing.

**AUTHORIZATION**

**NRL Problem A02-90**

Manuscript submitted July 26, 1956

**CONFIDENTIAL**

**CONFIDENTIAL**

**PROJECT VANGUARD REPORT NO. 7  
PROGRESS THROUGH JULY 15, 1956  
[UNCLASSIFIED TITLE]**

**PREFACE**

This report is intended as a general summary of the progress on Project Vanguard during the indicated period. Hence, minor phases of the work are not discussed to a great extent, and technical detail is kept at a minimum. It is hoped that the information here presented will be of assistance to administrative and liaison personnel in coordinating and planning their activities, and as a guide to the current status of the project. Material of a more technical nature will be published from time to time in separate reports which will be announced in subsequent monthly progress reports.

**COORDINATION WITH OTHER SERVICES**

**Army**

Funds for the establishment and operation of the Minitrack satellite tracking system have been approved. The Army is proceeding with the necessary steps to assume responsibility for establishing, operating, maintaining, and providing communications for seven Prime Minitrack stations. These Army stations will be established at:

Fort Stewart, Georgia  
Havana, Cuba  
Panama, C. Z.  
Quito, Ecuador  
Lima, Peru  
Antofagasta, Chile  
Santiago, Chile

Communications will link these stations to the data collection and computing center in Washington, D. C. Minitrack and telemetry equipment will be provided by NRL. The Army task is scheduled to have the stations established and operating by 1 October 1957 for the first satellite launching. Joint occupancy with the National Academy of Sciences optical tracking program with no additional requirements on station facilities, services, and equipment, is anticipated at Quito and Antofagasta. The program is being handled at Department of the Army level by the Office of the Deputy Chief of Staff for Logistics, Plans and Programs Division.

In response to a Department of the Army letter proposing the use of solar cells in Project Vanguard, a program has been discussed between NRL and SCEL involving:

1. The testing of solar cells as power devices in Aerobee-Hi flights early in 1957.
2. The use of solar cells as aspect indicators in experiments with the first two satellites.

**CONFIDENTIAL**

3. The development of a solar power source for possible use with Minitrack and telemetry in satellite flights late in the program.

This program is being offered to the Department of the Army in acceptance of their proposal.

Project Vanguard, by action of the secretary of the Navy, has requested the Department of the Army to transfer the first XN-2 model of the AN/FPS-16 radar from the Army to the Navy for essential use in Project Vanguard at AFMTC.

#### Air Force

The construction program for the Vanguard launching facility at AFMTC has been proceeding essentially on schedule. However, the full impact of the current steel strike on this construction schedule is not yet fully apparent. Approximately 366 tons of structural steel, consisting of wide-flange beams, channels, and angles, which were scheduled for shipment from the mills during June and early July, were not shipped prior to the date the strike was called. Every effort is being made to locate the required steel from warehouse stock in order to minimize the delay.

#### THE LAUNCHING VEHICLE

##### Configuration and Design

The current empty weight status of the launching vehicle is as follows:

Stage	Specification Weight (lb)	Target Weight (lb)	Current Weight (lb)
First	1782	1565	1526
Second	973	865	868
Third	89	89	82

##### Aerodynamics

The second subsonic wind tunnel test at the University of Maryland was completed on 23 May 1956. An analysis of the results has been started.

Re-entry temperatures have been calculated for the last stages of TV's 1 and 2. The results led to the general conclusion that for any normal flight the nose cone and bottle will heat up sufficiently to cause melting and structural failure during re-entry. Temperature calculations have also been made for the second-stage conduits and blisters of the launching vehicle during ascent, and recommendations for conduit materials have been made on the basis of these calculations. The aerodynamic heating of the retro-rockets during ascent has been estimated, and a preliminary design for a heat shield was arrived at for consideration by the vendors. Skin temperatures for TV-2 have also been estimated.

### Structures

An element destruction test has been performed on the first-stage engine thrust structure with the loading head inclined 7 degrees. Some mechanical interference which was observed between the yoke and gimbal ring at 82.5 percent of the design limit load is being investigated.

Consideration is being given to reducing the skin gages of the first-stage fuel and oxidizer tanks from 0.063 to 0.050 and from 0.050 to 0.040, respectively. The reduced skin gages would be used in the static structural test article, in TV's 3-5, and in the mission vehicles. With the reduced skin gage, the maximum allowable wind with the vehicle erected and in an empty condition would be 38.6 knots. An emergency system for lashing the vehicle to the gantry would be designed to allow the vehicle to withstand winds of 55 knots in the empty condition.

### Propulsion

During this period design effort at the Martin Company was concentrated on the propellant servicing equipment, auxiliary propulsion equipment, and propulsion test equipment. The preliminary design work for the lox and helium servicing systems was completed and vendors were contacted for the majority of the system components; about 50 percent of the components for the two systems were chosen. The lox system will be utilized for lox topping in TV's 0 and 1 and for remote filling of all remaining test and mission vehicles. The helium system will be used for compressed air servicing of TV's 0 and 1 and helium servicing of all remaining test and mission vehicles. The preliminary design work for the CO<sub>2</sub> system for static firings and general fire-fighting was also completed. This system, consisting of a bank of CO<sub>2</sub> bottles located adjacent to the equipment house, remotely operated valves, and several spray nozzles located on the firing stand, will be used for all test and mission vehicles. The design of the portable pressure sensor test box and the portable functional test panels for the first and second stages was completed and the major components were chosen. The portable units will be used for testing in the launch area.

### First Stage

The second GE demonstrator first-stage engine\* has been operated successfully for 150-seconds (full duration) with no adverse effects (Fig. 1). This was preceded by a successful 30-second test, following four attempted starts which were unsuccessful owing to electrical difficulties and subsequent automatic shutdown.

Evaluation of the tests with demonstrator engine No. 1 reveals that the performance was approximately as rated - a specific impulse of 255 seconds being obtained at a mixture ratio (O/F) of 2.1. The following changes have been made on the basis of the experience gained with this engine:

1. The oxidizer feed line has been thermally insulated.
2. The hydrogen peroxide main valve has been stiffened.
3. The oxidizer orifice size has been changed.

\*P.V.R. No. 6, p. 4

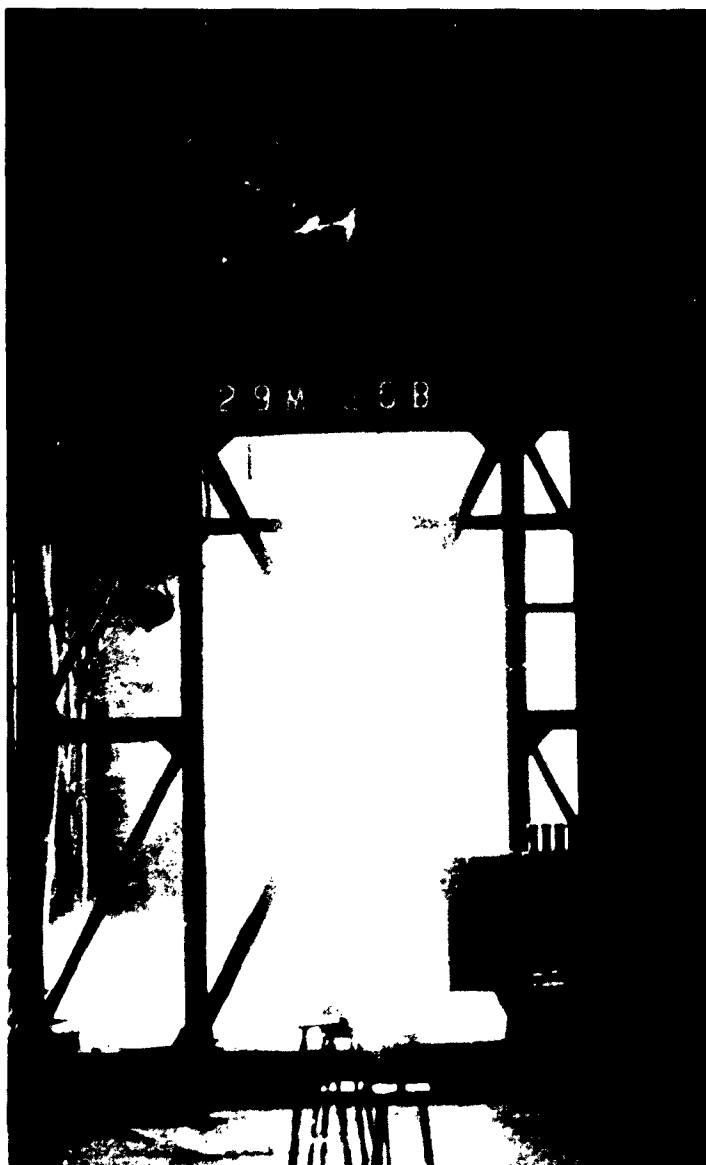


Fig. 1 - First full-duration firing of the prototype X-405 rocket engine in GE Malta Test Station pit No. 25

Grade B odorless kerosene (Shell No. 16185 UMF jet fuel) has now been selected as the first-stage fuel. No additives will be employed.

All components are now on hand, or available for modification, for the assembly of the first production engine.

Increased production quality control of the thrust-chamber liner wall thickness and some reduction of thickness at the throat have resulted in the elimination of the liner wall burning problem. Experiments are continuing with injector design variations in an attempt further to lower the combustion chamber wall temperature. The stainless steel configuration has been used predominately, but tests are continuing with the aluminum injector. A thrust chamber with a wall thickness at the throat of 0.060 inches and approximately double the present coolant velocity is being developed for evaluation.

Although production prototype X-405 turbopump assemblies are being received and tested, the testing of development models has been continued and has produced valuable information. One such unit has been run at 10 percent overpower for two full-duration tests, using water in lieu of propellants, with no noticeable ill effects. Considerable improvement in the buildup of oxidizer pump-out pressure is being realized through the incorporation of a refined impeller design. Seven prototype hydrogen peroxide decomposers have been received and satisfactorily tested. The life testing of one unit has already exceeded 20 full-duration full-power runs with no appreciable decay in efficiency of decomposition.

It has been found that in order to raise the structural resonance frequency of the rocket engine assembly, the actuator line of action should be directed through the center of percussion of the rotating mass. It has also been shown that because of the occurrence of flexure in the outer thrust-chamber shell, a "girdle" type bracket is required for the actuator attach points. These modifications have been incorporated and tested in several configurations, and a correlation of weight addition with increase of the resonant frequency has been obtained. It was discovered that these natural frequencies vary when the assembly is excited in different directions, being lowest in the plane bisecting the actuator lines of action and highest at right angles to that plane.

The design engineering on the first-stage pressurization system has been completed and drawings have been released for production. All procurement item components have been ordered from vendors and no delays are anticipated. The change to kerosene fuel may require a somewhat shorter tank because of the greater density of kerosene as compared to gasoline.

Vibration measurements have been recorded in two motor firings at the GE Malta Test Station. The recorded data are being reduced. Preliminary inspection of these data indicates that vibration due to engine starting and thrust buildup does not exceed the estimated value of 10 percent of engine thrust. Both of these firings had emergency shutdowns, hence no information on normal shutdown was recorded.

#### Second Stage

During this report period, injector performance commensurate with the specific impulse specified for the second-stage propulsion system was obtained with an aluminum one-on-one unlike-impinging injector. This design has demonstrated combustion stability over a

greater range of mixture ratios than the alternate showerhead design. However, this higher performance was achieved at mixture ratios (O/F) of the order of 2.2-2.3 as compared to the rated 2.8. It has also been indicated that performance can be improved somewhat by an increase in combustion chamber length. In all, 72 injector firing tests were made during this report period, with no destructive "hard starts."

Final assembly drawings of both the aluminum and stainless steel prototype second-stage thrust chambers have been completed. The first aluminum chamber has been completed after some difficulties with leaks and is now being installed for its initial firing test. Basic fabrication problems such as tube plugging with weld or braze material and excessive weld shrinkage persist, but the potential application of the Marbraze\* for aluminum chamber fabrication appears quite favorable. The possible substitution of 6061-T6 for the 5052-O aluminum alloy presently employed should be beneficial from the standpoint of both ease of brazing and somewhat better high-temperature properties in short-time service. The results of a two-dimensional heat transfer study of the throat section of a 162-tube 5052 aluminum alloy thrust chamber confirm the design feasibility of this type of thrust chamber for the Vanguard application, from the point of view of heat transfer. Film cooling does not appear to be necessary.

The design feasibility and inherent reliability of the restricted-grain heat generator for augmenting the helium pressurization system has been demonstrated in thirteen blow-down tests with a heavy-duty helium sphere. The unrestricted grain which had been carried as a backup development has been discontinued. The operational feasibility of the heated helium system would seem to be indicated by its employment in the rocket propulsion system of existing missiles. The preliminary phase of this development having been completed, emphasis is now being placed on establishing the best grain restriction technique and the development of reduced-weight hardware.

Three heavy-duty second-stage propellant tank assemblies have been completed (Fig. 2) and an expulsion test series has begun with water simulating the propellants. In the seven runs (six with the restricted-grain heat generators) completed to date, pressure regulation has been good and system performance normal. A prototype helium sphere of AISI - 410 stainless steel has been completed and prototype propellant tank domes have been fabricated. Evaluation of the heat-treat response and weldability of the 17-7 PH (Armco) steel is in progress, as an alternate which may permit a considerable reduction of the dry propulsion system weight.

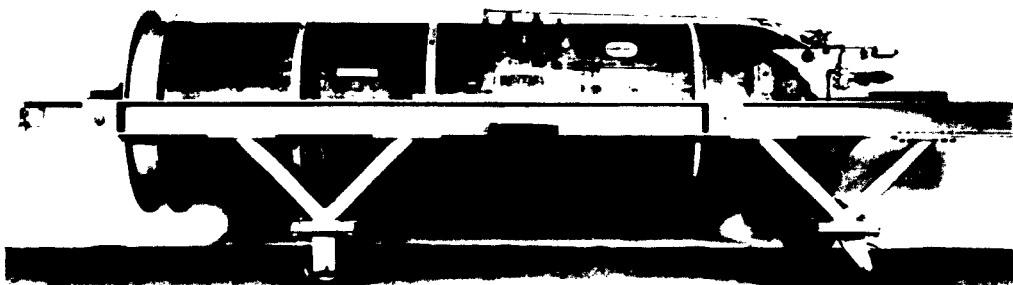


Fig. 2 - Heavy-duty second-stage propellant tank assembly for use in water-expulsion tests and initial thrust chamber firings

\*A Martin Company brazing process applicable to aluminum alloy materials.

Ten experimental oxidizer thrust-chamber valves have been fabricated, four of which have been checked on the test stand and found acceptable. The prototype valve will be basically identical to these experimental valves. Ten experimental fuel thrust-chamber valves have also been completed and fabrication of the lighter prototype has begun. Twelve prototype regulator valves have been completed. Oxidizer burst diaphragm tests have resulted in burst pressures below those specified. Steps are being taken to correct this through heat-treatment of the aluminum diaphragm support plates.

### Third Stage

The Allegany Ballistics Laboratory has conducted six full-scale propellant grain firings in a heavy-walled motor. The last four of these were fired for full duration and exhibited no resonance problem. The burning rate of the BDI propellant was somewhat higher than was anticipated, resulting in a chamber pressure of 370 psi as compared to the nominal 300 psi. A later modification of the propellant composition is planned to reduce its burning rate. In the meantime, chamber pressure has been reduced to 320 psi through increasing the throat diameter, with a slight reduction in efficiency (1/2 percent) due to the diminished nozzle expansion ratio. Nozzle throat erosion has been experienced, and the use of a coating on the graphite insert will be investigated. If this is not successful, the use of tantalum or other materials must be considered.

Two prototype fiberglass cases have been received, but these were overweight because of a somewhat resin-rich composition. One case has been given two hydrostatic tests to evaluate case closure attachment methods. The backup 4130 steel case development is being delayed by lack of material.

Two proposed systems for dynamically balancing the ABL rockets are presently being considered.

The Grand Central Rocket Company has fired nine full-scale propellant grains. Five of these tests were conducted in a heavy-walled case for performance evaluation. Four were in lighter cases that approached the prototype configuration and gave useful information with regard to case heating and the nozzle closure design. Propellant performance has proven slightly higher than anticipated, but problems have arisen in the bonding of the propellant grain within the case. Various bonding techniques are being investigated in a program of tensile testing. If direct bonding of the propellant to an aluminum oxide or 91LD (phenolic resin) coating is shown to be feasible, it may be possible to eliminate the polysulphide rubber insulating layer; a weight saving of approximately three pounds could thus be gained.

A machine for dynamically balancing the rocket motors has been ordered and plans for the environmental test program formulated. Two layouts for unit packaging are currently being presented to the Martin Company.

### Flight Control

#### Guidance

#### Reference System

Minneapolis-Honeywell has completed two prototype HIG-6 gyro units which are currently being tested. Of the four printed-circuit components included in the reference

unit, all but the power supply unit have been tested and accepted. Three base castings have been completed and are allocated as follows:

- No. 1 In spatial mockup
- No. 2 In first reference system package
- No. 3 In temperature testing

The ground equipment setup is progressing, but some delay is being experienced in the delivery of the second dividing head to be used in calibrating the gyros. In addition, the delivery of diodes has been somewhat delayed.

Evaluation of the cooling requirements for the gyro reference system are continuing. Efforts are presently directed toward determining the heat-sink characteristics of the over-all package for operation with no in-flight cooling.

#### Attitude Control

Delivery of the breadboard model of the Vickers autopilot magnetic amplifier was delayed to 15 June because of the changes in the filter circuits reported previously. The assembled breadboard is shown in Fig. 3. It consists of rack-mounted units which approximate the operational characteristics of the more compact prototype modular units but which have greater accessibility for effecting changes in circuit components. The two are compared in Fig. 4. The flight autopilot will be contained in two packages as follows:

Main amplifier, filter lead networks, and power supply	8-inch cube, 10 pounds maximum weight
First-stage internal control loop power amplifier	4-inch cube, 5 pounds maximum weight

At present both packages are under the specified weights by a considerable margin. An unqualified production-type autopilot is scheduled to be shipped by 1 September. All purchase items have been procured and all design items released as of 28 June 1956.

A test program has been established to verify the structural transfer functions on TV's 2 and 3, and structural transfer functions have been derived for the mission vehicles. A preliminary Nyquist plot indicates that no structural feedback problem exists at the static firing condition.

Controls tests have been started on the second-stage motor mockup. The TV-3 electronic amplifier and a second-stage servo were utilized in the preliminary tests.

#### Staging

A contract has been awarded to the Atlantic Research Corporation, Alexandria, Virginia, for the development, qualification and production of small solid-propellant rockets (50 lb thrust, 1.0-1.2 sec duration) for use in several of the Vanguard vehicle staging functions. It is presently planned to utilize these motors to provide energy for in-flight

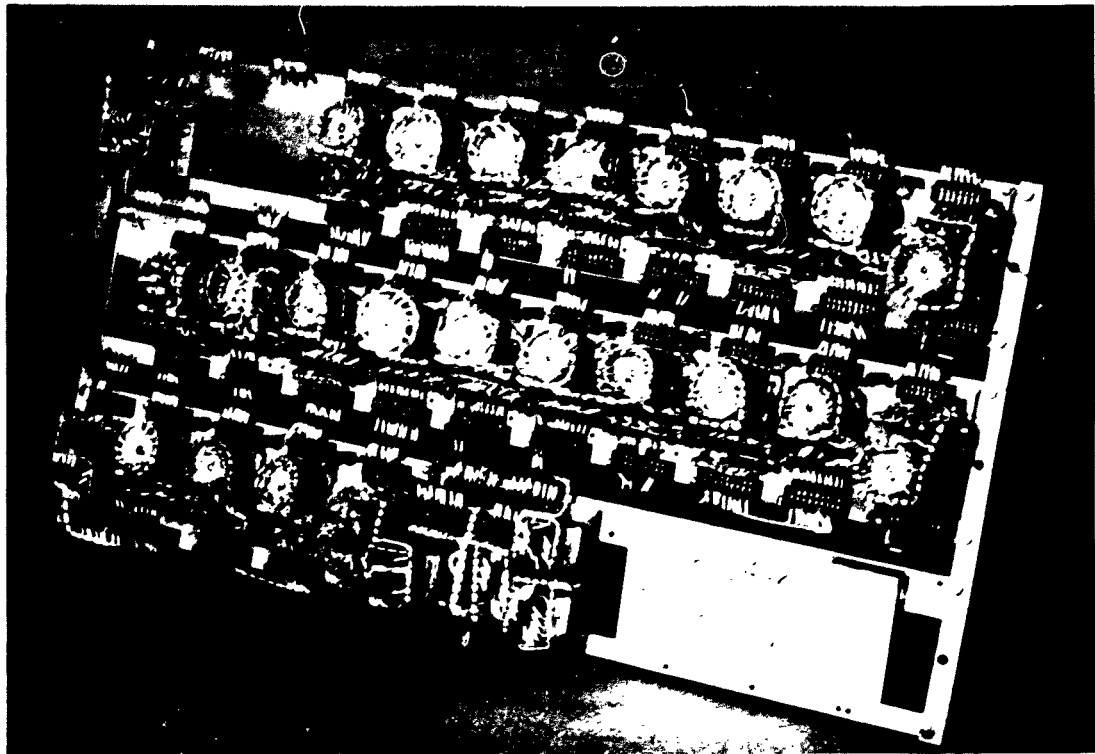


Fig. 3 - Completed magnetic amplifier breadboard unit showing conventional full-size servo-amplifier units

spinup of the third-stage rocket. In addition, deceleration of expended stages to effect separation can be accomplished by using a number of these units firing in a forward direction. A basic design has been established by ARC and thirty test motor firings have been conducted at ambient temperature, 20°F, and 130°F.

Considerable effort has been devoted to the evaluation of the danger of first-stage rideup upon the second stage at separation. The results show that the danger of rideup is at a minimum for any conceivable transient deviations occurring during first-stage thrust decay and second-stage thrust buildup, provided the effect of reactive force due to the impingement of the second-stage flame upon the first stage is considered.

The separation dynamic load analysis has been completed on an analog computer, and the data are now being reduced and analyzed. Transient loads due to separation, engine ignition, engine cutoff, and engine "hard start" will be obtained from this analysis. Preliminary inspection of the data indicates that transient loads in the longitudinal direction are not excessive.

The design of an explosive bolt, to be used in the separation of the nose cone in TV-4 and the remaining vehicles, has been completed. This bolt will be pressure-sealed and will contain two DuPont E-77 detonators.

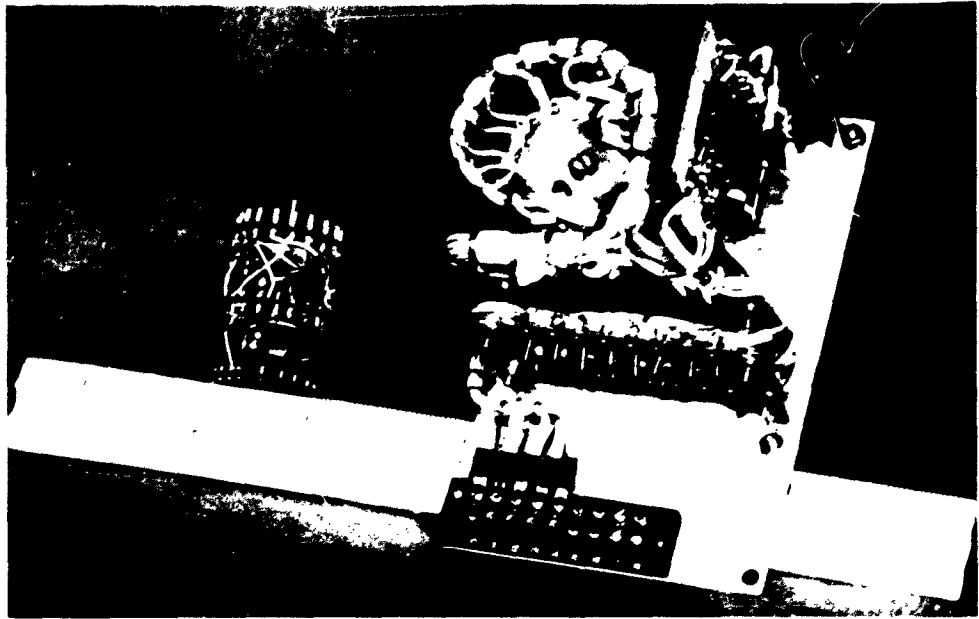


Fig. 4 - Comparison of breadboard and flight amplifier modular units

#### Electrical Systems

All electrical circuitry for the first and second stages of TV-2 have been completed, and major electrical components for these vehicles have been ordered. All assembly drawings and major installation provisions for electrical equipment have been released for this vehicle.

#### Manufacture

During this period the following launching vehicle test items were completed:

1. Lox seals
2. Structural test tail section
3. Thrust cylinder centering fixture for first stage

Second-stage structural drawings for TV-3 and the subsequent test vehicles have been released for manufacturing. Test vehicle structural releases are now complete with the exception of the nose cone to be used on TV's 4 and 5.

Spare components for the field test program have been reviewed by the Martin Company. It was agreed that sufficient major spares should be stocked to allow system tests of spares prior to shipment of the rocket to the field. Since this policy might result in excessive obsolete spares, it was tentatively agreed that only one set of spares would be used for TV-2 and the TV-2 backup. All remaining vehicles will have system-tested controls spares delivered with them in the fields.

## ELECTRONIC INSTRUMENTATION

### Vehicle Telemetering

#### General

AFMTC has been requested to locate the telemetry trailer site at coordinates  $X = 638,400$ ,  $Y = 1,499,810$  at Cape Canaveral, to provide a stabilized trailer parking area, access road, power, communications, and timing signals, and to lay NRL-provided coaxial cable to the launching area for closed-loop checkout of telemetry equipment. NRL has procured a 6500-foot Heliax coaxial cable system, including a pressurizing system, for delivery to AFMTC by 15 July 1956. NRL has also procured six 25-kva line transformers for installation at the site, since AFMTC could not procure these items in time to meet the needs of Project Vanguard.

Ground power supplies to provide external power to rocket telemetering equipment in plant tests have been delivered to the Martin Company.

AFMTC is purchasing, through NRL, six 3-element helix antennas from the New Mexico College of Agriculture and Mechanic Arts to support Vanguard telemetry needs at downrange island stations; delivery of one antenna by October 1 has been requested. Personnel assistance has already been obtained from NMCA&MA on the new ONR-sponsored contract which became effective on 5 June, and antenna development and prototype fabrication are now in progress.

Plans are being made for equipment and wiring installations in the Vanguard part of the blockhouse, which is being shared with the Douglas Aircraft Company. The requirements for the intercom and telephone communications net have been included in the Vanguard Test Program and submitted to AFMTC for action.

It has been found that Ansco Plenachrome film will be satisfactory for ground recording purposes, although the emulsion carrier is thicker than that of Eastman Verichrome; 20 rolls of the Plenachrome are being procured, and 120 rolls of Verichrome have already been procured from Eastman-Kodak Ltd. of London. No further steps have been taken with regard to the Gaevert film also under consideration.

The delivery of Silvercel batteries and battery boxes for telemetering and range instrumentation needs has been made to the Martin Company.

Two trailers which were to be received by 8 June have been delayed; one is now on hand and the other will be delivered by 30 July. This will result in a delay in shipment of the mobile ppm/am and pwm/fm ground stations to AFMTC, scheduled for 1 August, to perhaps 17 August.

#### PPM/AM Systems

The prototype r-f oscillator using the Amperex type 6360 tube has been tested and accepted for use in the ppm/am first-stage telemetering transmitters; the transmitter output will be approximately 40 watts.

The first Elsin Electronics ppm/am ground station has been tested and accepted. Certain component changes which have been made to improve performance and reliability

will be included in the units now in production. The NRL-constructed ppm/am ground station has been tested and delivered to the Martin Company, and the instruction of Martin personnel in the use of this station has been completed.

The NRL model shop has completed the wiring and adjustment of the four ppm/am calibrators; the six low-noise insertion amplifiers for ground station ppm/am receivers have also been adjusted, tested, and accepted.

All AN/DKT-7 (XN-1) ppm/am vehicle telemetering transmitters and spares for TV-0 have been delivered to the Martin Company.

#### PWM/FM Systems

The pwm/fm vehicle telemetering transmitter and spares for TV-0 have been delivered to the Martin Company.

Systems tests have been conducted on the recording pwm/fm ground station, and installation in the trailer is now underway. A Precipitron has been ordered for use with the magnetic tape recorder.

#### FM/FM Systems

The vehicle fm/fm transmitter contract was let to the Hoover Electronics Corporation for nine units rather than the five erroneously reported.\* A new supplier, Radiation Incorporated, has been found for the crystal controlled rf oscillators, and a test oscillator has already been delivered to Hoover. A potential delay due to a scarcity of the subcarrier oscillators made by the Electro-Mechanical Research Corporation is being resolved through the cooperation of that corporation and the Northrup Aircraft Corporation.

The AN/UKR-5 pwm/fm and fm/fm ground station intended for installation in Hanger C at AFMTC is ready for shipment at NADC, Johnsville, Pennsylvania. The procurement of an Ampex magnetic tape recorder for use with this station is under consideration.

#### Vehicle Tracking

The second of the three AN/DPW-1 radar beacons received from WSPG† has been tested and delivered to the Martin plant; the third unit will be tested and then shipped directly to AFMTC on 15 August.

The overall performance of the AN/DPN-19 radar beacons has been improved by component changes; modification of the first units has begun, and environmental tests will begin on 6 August.

Melpar has begun work on the AN/DPN ( ) S- and C-band radar beacons (Melpar 1245). Delivery of the first S-band unit is expected on 20 September and the first C-band unit on 4 October.

\*P. V. R. No. 6, p. 12

†P. V. R. No. 6, p. 12

A proposal has been received from the Hazeltine Electronics Company for the modification of three S-band AN/DPN-31 radar beacons to C-band, and for the construction of one C-band beacon. One S-band beacon is being furnished by the Army Signal Corps, and an attempt is being made to obtain two S-band units (to be modified by Hazeltine) as government furnished equipment from the White Sands Signal Corps Agency.

Two DOVAP transponders from BRL have been tested and delivered to the Martin Company. A transistorized power supply is under development for use with the DOVAP transponder.

#### Range Safety

Three AN/ARW-59 range safety command receivers and decoders have been modified, tested, and delivered to the Martin Company; two additional units are being modified and tested for delivery by 1 August. No other units have been received from BuAer.\*

The Collins Radio Company began work on the mission vehicle receivers on 26 June, although to date no contract exists for the Vanguard part of the BuAer receiver program.

The range tracking monitor and ground control rack and power supply for the hanger at AFMTC has been completed, and the blockhouse racks are nearly completed.

The New Mexico College of Agriculture and Mechanic Arts has begun work on the blockhouse DOVAP monitoring antennas. A dipole has been selected as the 37-Mc antenna, and a helix with a 60-degree beamwidth and a 5-db gain is being constructed for 74 Mc. Inasmuch as AFMTC has dropped the requirement for third-stage cutoff equipment in TV's 1 and 2, work on the two-channel decoder has been stopped.

#### THE SATELLITE

Models of the 20-inch satellites† have been constructed and two models are undergoing structural tests. One has a 0.020-inch shell and a light structure; the other has a 0.032-inch shell and a slightly heavier structure. Both are made of 5052-0 aluminum alloy. Each hemisphere contains a pressurized zone which has been hydrostatically tested to determine its structural strength. Because of variations in strength which are attributed to manufacturing tolerances, a larger margin of safety will be required than has been realized to date. Tests on additional hemispheres of a modified design are scheduled for the week of 16 July. Preliminary vibration tests indicate a need for more strength near the attachment to the third stage.

A complete 6-inch model‡ with spring-actuated antennas and internal configuration has been successfully vibration tested in three planes. The structures for the 6-inch satellite will be fabricated by Brooks and Perkins, Incorporated, of Detroit. Drawings for the fabrication of this unit in magnesium (FS-1 alloy) have been given to B&P, and delivery of four units for test purposes will be scheduled for two months from the date of the contract which will be signed in the latter part of July.

\*P. V. R. No. 6, p. 12

†P. V. R. No. 5, p. 16

‡P. V. R. No. 4, p. 14

The spring type antennas have been vibration tested and have met specifications; they have also been given a static structural test, and they are considered adequate from a functional and structural point of view.

The basic design of the satellite separation device has been established and Raymond Engineering Laboratories, Incorporated, is the contractor. Delivery of a working model will be scheduled for two months from the date of the contract, which will be signed in the latter part of July.

### THE MINITRACK SYSTEM

Bids have been received and analyzed from six of the thirteen prospective contractors for the procurement of ten Minitrack ground station units.\* Evaluation of the bidder's capabilities, based on the technical requirements of the specifications submitted for this procurement, have been completed and this information forwarded to the Contract Division, Office of Naval Research, for selection and notification of the successful bidder. The awarding of this contract is scheduled for not later than 20 July 1956.

The Blossom Point Minitrack Test Facility is not yet completed, owing partly to rainy weather delays in the field construction schedule and partly to unavoidable delays in arranging for the individual contracts required. The complete prototype Minitrack ground station unit (Fig. 5), mounted in its trailer, scheduled for transport to Blossom Point from NRL by 5 July, has been kept at NRL because the power and water installations and the parking pad were not then completed at Blossom Point. Tests and calibrations of this unit have been continuing at NRL, however, and it is felt that as far as the technical phases of the program are concerned, little actual time has been lost. A firm date of 23 July has now been set for transport of this trailer to Blossom Point, with all of the facilities required for its use there to be completed prior to this date.

All of the 14 antenna array support posts and rails† are installed and surveyed at Blossom Point. Six D.S. Kennedy antenna arrays were assembled on these rail mounts under the direction of a D.S. Kennedy representative on 11, 12, and 13 July. A Technical Appliance Corporation representative will be present on 17, 18, and 19 July to assemble the TACO antennas. Ditching and installation of the connecting rf feed cables between these antennas and the trailer site will be completed by 20 July. The trailer pad and access road have been completely graded, and pad concrete pouring will proceed on 18 July, allowing about 5 days of curing before installation of the trailer on 23 July. Water will be provided by 23 July. The administration and laboratory building is now on site, unassembled, and the floor pad is complete. Construction of this building, including all wiring, plumbing, and interior finishing, will be completed by 26 July.

On the basis of the above dates, complete station operation now appears certain during the week of 23-27 July. Immediately after this phase, the calibration and antenna evaluation phases will be started, with representatives of the contractor for the ground station units to be on hand from 1 August to 1 October. Although there have been delays in the station construction phase of the program, it is believed that no overall program delays will result, because the technical testing of the trailer-mounted equipment has been continuing at an accelerated pace at NRL.

\*P. V. R. No. 6, p. 14

†P. V. R. No. 5, p. 20

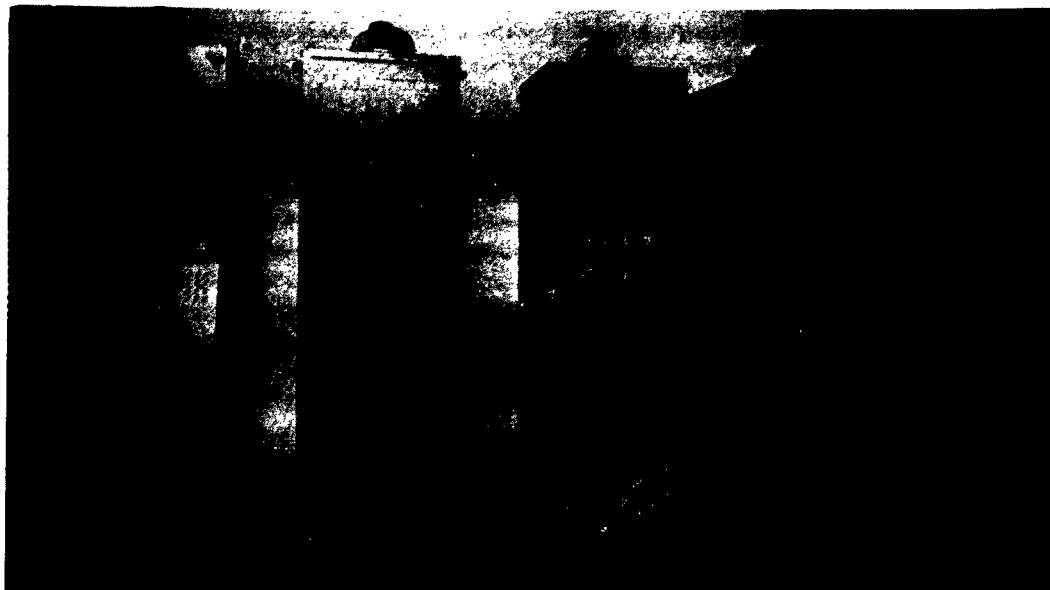


Fig. 5 - Complete prototype Minitrack ground station unit

## DATA PROCESSING

### Telemetered Data

Radiation, Incorporated (Melbourne, Florida) was the only company to submit a bid on the automatic recording and reduction facility for telemetered data as proposed by NRL. Some of the technical details of the proposal are now being resolved with the company, and it is expected that a contract will be negotiated for this equipment with Radiation, Incorporated by the end of July.

### Orbital Data

The contract for the satellite-orbit digital computing facility has been executed by the International Business Machines Corporation and by the Navy. The computing facility, to be furnished and operated by IBM on company premises, will consist of a primary computing center and at least one secondary center to be used only in case the primary center fails to function properly. The primary computing center will be located in Washington, D. C. and will consist mainly of an IBM Type 704 computer and auxiliary equipment. The secondary computing center will consist of the same type of computer but will be located in another city, probably New York. A detailed description of the operation of the orbit computing facility was given in an earlier report.\*

\*P.V.R. No. 2, pp. 13-14

**Second-Stage Apogee Prediction**

On the assumption that an AN/FPS-16 radar will be installed on Grand Bahama Island for tracking the second stage of the launching vehicle, AFMTC is studying the feasibility of the transmission of this tracking data in digital form over the submarine cable to Cape Canaveral. Further, AFMTC is studying the use of this data for predicting the second-stage apogee, and is giving primary consideration to use of the IBM Type 704 Computer for this purpose, since such a computer will be installed at Cape Canaveral about August 1956.

\* \* \*

CONFIDENTIAL

CONFIDENTIAL

Naval Research Laboratory. Report 4815.  
PROJECT VANGUARD REPORT NO. 7 - PROGRESS  
THROUGH JULY 15, 1956, by Project Vanguard Staff,  
16 pp. and figs, July 27, 1956.

1. Satellite vehicles -  
Launching
2. Satellite vehicles -  
Research
3. Rockets -  
Development
1. Project Vanguard

CONFIDENTIAL

CONFIDENTIAL

Naval Research Laboratory. Report 4815.  
PROJECT VANGUARD REPORT NO. 7 - PROGRESS  
THROUGH JULY 15, 1956, by Project Vanguard Staff,  
16 pp. and figs, July 27, 1956.

1. Satellite vehicles -  
Launching
2. Satellite vehicles -  
Research
3. Rockets -  
Development
1. Project Vanguard

CONFIDENTIAL

CONFIDENTIAL

Naval Research Laboratory. Report 4815.  
PROJECT VANGUARD REPORT NO. 7 - PROGRESS  
THROUGH JULY 15, 1956, by Project Vanguard Staff,  
16 pp. and figs, July 27, 1956.

1. Satellite vehicles -  
Launching
2. Satellite vehicles -  
Research
3. Rockets -  
Development
1. Project Vanguard

CONFIDENTIAL

Naval Research Laboratory  
Research Reports Library  
Code 5596.3

Date: 13 Dec 07

From: Judi Griffin code 5596.3

To: code 8100

CC: Vicki Cicala code 1226.3

Subj: Review of VANGUARD Progress reports for distribution change

FR 4748 - AD0343044  
4767 - AD0341439  
4728 - AD0340793  
4717 - AD0340793  
4800 - AD0342755  
4815 - AD0342991  
4860 - AD0342505  
4880 - AD0343187  
4890 - AD0343093  
4900 - AD0342883  
4910 - AD0343031  
4930 - AD0342912  
4950 - AD0342643  
4995 - AD0139582  
5010 - AD0342966  
5020 - AD0342882  
5035 - AD0142782  
5050 - AD0343170

Please Review: FR-4717, FR-4728, FR-4748, FR-4767, FR-4800, FR-4815, FR-4832,  
FR-4860, FR-4880, FR-4890, FR-4900, FR-4910, FR-4930, FR-4950, FR-4995,  
FR-5010, FR-5020, FR-5035, FR-5050, FR-5113, FR-5185, FR-5217, FR-5227

For possible Distribution Statement Change to: APPROVED FOR PUBLIC  
RELEASE - DISTRIBUTION UNLIMITED

Thank You

Judi Griffin

(202) 767-3425

[Judi.griffin@nrl.navy.mil](mailto:Judi.griffin@nrl.navy.mil)

5113 - AD0343179  
5185 - AD0203877  
5217 - AD0204045  
5227 - AD0206096  
4832 - AD0343162

The Subject Report(s) can be (please sign after appropriate change):

Changed to Distribution A (Unlimited)

*R.G. Wilhelm*

Changed to Classification \_\_\_\_\_

Other: \_\_\_\_\_